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BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C.

In the Matter of	)	
	)	**ACCEPTED/FILED**
Requests for Waiver of Section 22.913 of the Commission's Rules to Permit AT&T to Use a PSD Measurement in the Cellular Bands of a Limited Number of Test Markets	))))	JUL 1 2014 Federal Communications Commission Office of the Secretary

WAIVER – EXPEDITED ACTION REQUESTED
REQUEST FOR RULE WAIVER
FOR CELLULAR MARKET AREA 248 IN VERMONT

Pursuant to Section 1.925 of the Federal Communications Commission's (the "Commission") rules, AT&T Services, Inc., on behalf of AT&T, Inc. and its subsidiaries ("AT&T"), hereby respectfully requests a limited waiver of Section 22.913 of the Commission's rules.[1] Section 22.913 requires the use of an Effective Radiated Power ("ERP") measure for determining cellular base station power transmission limits. AT&T has proposed[2] that the current rule for cellular base station power limits should be restated to include a power spectral density ("PSD") measure as an alternative to the ERP measure. Offering cellular carriers the option to use a PSD measure for calculating cellular base station power limits would eliminate unintended penalties on the deployment of advanced digital broadband modulation schemes in the cellular bands. The market for which AT&T seeks a waiver of the ERP requirement is in Vermont and is located in CMA

[1] 47 C.F.R. § 22.913.
[2] *In the Matter of Amendment of the Commission's Rules Governing Radiated Power Limits in the Cellular Radio Service Frequency Bands,* Petition for Expedited Rulemaking and Request for Waiver, RM-11660, DA-12-701 (filed February 29, 2012) ("PFR"). The request for a waiver was not placed on public notice.

market of Burlington, VT (CMA248). Exact geographic boundaries are defined by these licenses.[3]

BACKGROUND

On February 29, 2012, AT&T filed a petition for expedited rulemaking and a request for a blanket waiver of 47 C.F.R. § 22.913 pending disposition of its PFR.[4] Thereafter, the Wireless Telecommunications Bureau sought comment on the PFR only, taking no action on the requested waiver.[5] Pending disposition of the PFR AT&T intends to file license specific waivers as needed for efficient deployment of high speed wireless broadband services.

In this petition for a waiver of section 22.913 of the Commission's rules, AT&T seeks authority to initiate power spectral density operations in the cellular band in Vermont. The operations will take place subject to conditions intended to assure that public safety systems operating in adjacent bands will not experience an increased risk of interference. Consistent therewith, AT&T respectfully submits this waiver request to employ a power spectral density measure for cellular base station emission limits in the Vermont market noted above.[6]

AT&T'S WAIVER REQUEST MEETS THE WAIT RADIO STANDARD SINCE GRANT OF THE WAIVER WILL NOT FRUSTRATE THE UNDERLYING PURPOSE OF THE RULE AND GRANT IS IN THE PUBLIC INTEREST

Under Section 1.925(b)(3) of its rules, the Commission may grant a request for waiver if the applicant demonstrates that: (i) the underlying purpose of the rule would not be served or would be frustrated by its application to the instant case, and that the grant of the requested waiver would be in the public interest; or (ii) in view of unique or unusual factual

[3] The license is KNKA797

[4] *See,* n. 2 above.

[5] *Wireless Telecommunications Bureau Seeks Comment On Petition For Rulemaking Filed By AT&T to Make 800 MHz Cellular Base Station Power Rules Consistent With Rules for Other Mobile Broadband Services,* DA-12-701 (Released: May 2, 2012).

[6] *See,* n.3

circumstances, application of the rule(s) would be inequitable, unduly burdensome, or contrary to the public interest, or the applicant has no reasonable alternative.[7] In this case, as described in this waiver request, AT&T contends that a waiver of the power limits to permit AT&T to use a PSD measurement in the designated Vermont markets will not undermine the purpose of the rule – to minimize interference – and will be in the public interest by allowing AT&T to deploy wideband LTE.

One of the Commission's core missions is to manage spectrum effectively and ensure that licensees do not interfere with each other. 47 U.S.C. § 302. Thus, the Commission establishes power limits on specific services in part to ensure that wireless services in adjacent bands do not cause harmful interference to each other's service. As part of this waiver request, AT&T has submitted a study that shows that permitting the use of a PSD measurement will not increase interference in any of the subject markets, discussed in more detail below. (Attached as Appendix A) Therefore the underlying purpose of Section 22.913 will not be frustrated, as the interference environment remains the same or better under the PSD calculation as the current ERP measure.[8] Allowing the alternative measurement maintains or improves the interference environment that the Commission found to be reasonable when it established the rule. In addition, the use of the 800 interference website, established under Section 90.674 of the Commission's regulations, which requires 24 hour response to public safety requests for interference mitigation in most cases, will satisfy any remaining concerns about interference into public safety systems by AT&T's use of a PSD calculation in the markets at issue. The 800 MHz website can be found at

[7] *See,* 47 C.F.R. §1.925; *WAIT Radio v. FCC,* 418 F.2d 1153 (D.C. Cir. 1969).

[8] In fact, it is AT&T's understanding that no Public Safety Agency operating in the license area is operating in the 800 MHz bands.

http://www.publicsafety800mhzinterference.com/CTIAWeb/index.aspx.[9] Given that the underlying purpose of the rule will not be undermined by using a PSD calculation the first prong of the WAIT RADIO standard has been met.

Grant of the requested relief would be in the public interest because: (i) the waiver would remove disparities between radio services that limit cellular carriers' ability to deploy the most efficient and advanced modulation techniques;[10] and (ii) the waiver would promote the deployment of mobile broadband services consistent with the policy goals enumerated in the National Broadband Plan. Chairman Wheeler said in his March 24, 2014 remarks at the Brookings Institute:

> "Our role is to harness the power of modern communications to produce social and economic benefits. This we can accomplish in two ways. First, by removing obstacles to progress, whether the obstacles are unnecessary or counterproductive regulations or private arrangements that restrict economic, intellectual, and cultural advancement. And second by assuring the availability of the economic inputs we manage which are essential to modern networks. By far the most important of these inputs is spectrum." [11]

Both of the Commission's important goals are met by granting this waiver and ultimately changing the rules – removing counterproductive regulations and increasing spectrum efficiency.

Carriers have experienced extraordinary increases in the volume of data generated by consumers and businesses as a result of the popularity and ubiquity of smartphones and other data-enabled devices. Having pioneered devices like the iPhone and aggressively promoted the

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[9] AT&T notes that the Commission found that the interference notification procedure found in Section 90.674 was adequate to address public safety concerns regarding interference notification, and allowed Sprint Nextel to exceed channel spacing and bandwidth requirements in the 800 MHz band under the existing technical rules. *In the Matter of Improving Spectrum Efficiency Through Flexible Channel Spacing and Bandwidth Utilization for Economic Area-based 800 MHz Specialized Mobile Radio Licensees,* WT Docket No, 12-64, WT Docket No. 11-110; Report and Order (May 24, 2006) at ¶ 17.
[10] *See,* PFR at 9–12.
[11] Prepared remarks of FCC Chairman Tom Wheeler, "WIRELESS SPECTRUM AND THE FUTURE OF TECHNOLOGY INNOVATION" FORUM – Brookings Institution, March 24, 2014http://www.fcc.gov/document/chairman-wheeler-remarks-brookings-institution

latest technologies and applications, AT&T has also documented that its network has borne the brunt of a substantial amount of this newly generated traffic. In 2013 alone AT&T invested $25B in capital and spectrum to build and enhance its networks. [12] Notwithstanding that massive investment, AT&T remains critically constrained by access to spectrum; yet, if it is to maintain a high-quality level of service for its customers, AT&T must nevertheless rapidly and aggressively roll-out LTE services even as it faces these spectrum constraints.

To this end, AT&T needs to enhance its already deployed LTE carriers with the proposed PSD power limits on its cellular spectrum in the Vermont market beginning the August 31, 2014 to meet the demand associated with the start of the school year, but needs authorization to start planning/deployment process August 1, 2014. The need for relief as soon as possible is critically important for a number of reasons. If AT&T can make use of its existing 800 MHz cell spacing for LTE services, there are great efficiencies in deployment, since the roll-out will use existing infrastructure. Thus, grant of the requested waiver will allow AT&T to maximize LTE deployment in the subject market.

THE INTERFERENCE STUDY

A PSD-based cellular power limit will not cause increased harmful interference to adjacent frequency bands. As noted in its PFR, AT&T compared the potential interference effects of various wireless network arrangements on public safety receivers. A similar study reflecting Vermont specific data addressed three near/far interference mechanisms common in public safety interference environment – Intermodulation, Out of Band Emissions ("OOBE"), and Receiver Overload. The benchmark used to measure significant interference was a rise in the receiver's noise floor greater than 1 dB for intermodulation and OOBE interference. The study assumes

[12] AT&T Inc. 2014 Annual Report at 7
http://www.att.com/Investor/ATT_Annual/2013/downloads/ar2013_annual_report.pdf

public safety operation in the 800 MHz band although it is AT&T's understanding that there is no Public Safety Agency operating in the license area. For receiver overload, the benchmark was a received interference level higher than the overload limit of the affected receiver. Public safety receiver performance was based upon current models with relatively wide open front end filtering encompassing the range from 851-869 MHz. The Public Safety receiver bandwidths of 12.5 and 25 KHz were assumed for the study.

By examining five different cases that represent AT&T's past, present, and future wireless networks, the study showed there would be no significant effects upon adjacent services. The cases are composed of GSM, UMTS and LTE systems in various configurations in the cellular band. The purpose of this comparison was to show that future deployments of 2X2 MIMO[13] LTE in the cellular bands under a PSD limit would maintain the *status quo* with respect to the potential interference impacts on adjacent services—and in particular, the Public Safety services. With respect to intermodulation interference, at the three distances from the cellular base station site (40 meters, 200 meters, and 1000 meters) for all migration paths, the noise floor rise for LTE deployments with MIMO and PSD rules relief were significantly less than present technology deployments. For OOBE at the three distances from the cellular base station site for all migration paths, all noise floor rises were below 1 dB. This rise in the interference floor is insignificant in practice and is still well under the 1 dB degradation in the noise floor of the public safety mobile receiver. Finally, for overload interference, the study showed LTE deployments did not increase the number of possibilities of such interference above that of existing deployments.

[13] To increase spectral efficiency and throughput of a radio link, multiple transmitters using the same frequency and multiple antennas or multiple elements of the same antenna are used to create multiple distinct spatial channels between the transmitters and antenna(s). With the aid of a multipath environment and signal processing, multiple channels are created using the same frequency at each transmitter. This technology is referred to as MIMO (Multiple Input Multiple Output).

The study results demonstrate that the interference environment into Public Safety units from 2X2 MIMO LTE cellular deployments planned by AT&T is not appreciably different from that of existing cellular deployments—and in some cases it is better. The study results also showed that a power spectral density limit based on a maximum power level of 2500 watts (2500 Watts/10 MHz or 250 Watts/MHz for non-rural areas) and 5000 watts (5000 Watts/10 MHz or 500 Watts/MHz in rural areas) should exhibit about the same or less interference impacts as existing deployments.

As noted, AT&T's petition seeks to maintain the status quo in the RF environment of neighboring public safety service areas. This conservative RF approach also applies to CMRS service areas as well. AT&T chose its PSD limit based on existing transmit power levels at its sites. By maintaining the existing total power levels at its sites, AT&T's power levels into adjacent public safety and CMRS service areas with the new PSD limit would be the same as before. AT&T will not inject increased signal energy into these bordering areas and will not increase the noise level in those areas. Under the AT&T PSD limit, the power injected into neighboring receivers either in adjacent areas or co-located sites does not increase but remains the same. Consequently, the effect on neighboring and co-located systems – both public safety and cellular services – is minimal.

This is especially true for neighboring cellular systems because *there are no U.S. neighbors* for AT&T's 850 A band licenses in this Vermont market and signal strength at the Canadian border is governed by treaties and coordination agreements. Hence, no harmful effect to neighboring systems is possible in those bands. The B band cellular licenses are held by Verizon, who supports AT&T's PFR. Indeed, in addition to its support of AT&T's PFR, Verizon has proposed *higher* PSD limits than those proposed by AT&T, [14] a fact that suggests Verizon Wireless itself anticipates no harmful effects from the grant of this waiver request.

For these reasons, AT&T requests that the FCC grant it a waiver to permit it to use the PSD measurements specified in its PFR in lieu of the power limits currently specified in section 22.913 of the rules for testing and operations in the Vermont market noted above. AT&T fully expects that any such waiver would be conditioned on the outcome of the rulemaking proceeding proposed in its PFR. Moreover, the waiver—conditioned on the outcome of the proposed rulemaking—would not undermine the deliberative process relative to adopting PSD limits for cellular carriers more broadly. For the foregoing reasons, AT&T urges the Commission to act quickly and grant AT&T permission to use PSD-based power measurements for its cellular systems by August 1, 2014.

[14] "However, rather than adopting relatively low PSD limits as AT&T proposes, the Commission should adopt both PSD and power flux density ("PFD") limits. By adopting PSD and PFD limits, the Commission can adopt PSD limits consistent with those adopted for other bands, resulting in better coverage and data throughput, while still protecting adjacent licensees from harmful interference." Reply Comments of Verizon Wireless at iii. "PFD represents the total power in a portion of spectrum localized over an area on the ground relative to a nearby base station transmitter. PFD limits are used to establish maximum in-band co-channel signal levels on the ground near the base station. Limiting PFD levels near the base station is an effective way to ensure that signal strength generated by the base station does not over power receivers operating on adjacent bands." Reply Comments of Verizon Wireless at Footnote 5

CONCLUSION

For the reasons discussed above, AT&T respectfully requests that the Commission waive section 22.913 of the rules, which require use of Effective Radiated Power ("ERP") measure for determining cellular base station power transmission limits, and permit AT&T to initiate power spectral density operations in the cellular band in areas of Vermont described herein.

Respectfully submitted,

William L. Roughton, Jr.
General Attorney

AT&T Services, Inc.
1120 20th Street, NW
Suite 1000
Washington, D.C. 20036
202-457-2040
202-549-7023 (Mobile)
202-457-3073 (Fax)

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APPENDIX A

Radio Access and Devices – Wireless Technology Strategies

Date: **May 14, 2014**

Subject: **A Further Comparison of the Impacts on Public Safety Receivers from the Various Wireless Technologies used in AT&T's Migration from Narrowband GSM to Broadband LTE in the 850 MHz CMRS Cellular Band in Vermont**

Author: **Doug Duet**
4C46 Lenox Park
(404-499-6420
(404) 499-6500 (fax)

Abstract

The FCC Rules for the 850 MHz band were designed to accommodate first generation AMPS (Advanced Mobile Phone System) analog cellular service. Over the years, carriers deployed digital services in the 850 MHz bands, and eventually sunset analog services. Carriers currently use the 850 MHz band for technologies that support mobile broadband, such as UMTS. As the industry moves toward fourth generation LTE (Long Term Evolution) technology coupled with the use of MIMO (Multiple Input Multiple Output) techniques for spectral efficiency improvements, it is appropriate to consider whether the rules for this band relating to power measurement, which were adapted for technology deployed almost 30 years ago, should be revised to accommodate LTE. In band plans adopted more recently to accommodate mobile broadband deployment, the Commission has adopted a Power Spectral Density approach. This paper presents the results of a further study that considers whether making such a change to the 850 MHz rules to accommodate contemporary commercial mobile broadband deployments would increase the likelihood of interference to adjacent users of Public Safety bands in a Vermont market.

The study addressed the interference impacts on Public Safety receivers under five different cases that are representative of AT&T's past, present, and future network comprising GSM, UMTS and LTE systems in various configurations in the cellular band. Results of this "real world" study again leads AT&T to conclude that a power limit based on a Power Spectral Density measure will not increase the possibility of harmful interference to adjacent bands and would maintain the "status quo" with respect to the potential impact on users of adjacent spectrum, such as the Public Safety Radio Service. The "real world" study results also supported a Power Spectral Density limit of 250 Watts/MHz in non-rural areas and 500 Watts/MHz in rural areas. As a result of this study, AT&T will file a petition at the FCC proposing to supplement the current per-emission ERP limits for cellular base stations with ones restated to include power spectral density limits.

1. Introduction

The FCC Rules for the 850 MHz band were designed to accommodate first generation AMPS (Advanced Mobile Phone System) analog cellular service. Over the years, carriers deployed digital services in the 850 bands, and eventually sunset analog services. Carriers currently use the 850 MHz band for technologies that support mobile broadband, such as UMTS (Universal Mobile Telecommunications System). As carriers migrate their wireless networks to fourth generation (4G) LTE (Long Term Evolution) technology and use MIMO (Multiple Input Multiple Output) techniques for spectral efficiency improvements, the FCC Rules governing the radiated power of transmitters in the Cellular Radiotelephone Service have come into question. MIMO uses multiple antennas or multiple antenna elements at both the transmitter and receiver to create multiple distinct spatial channels between the transmitter and the receiver using the same radio channel. AT&T plans to use 2x2 MIMO in its 850 MHz LTE deployments. 2x2 MIMO uses two transmitters operating on the same carrier channel but carrying two different information streams to create two separate spatial channels. Since two spatial channels are created using a single radio carrier, spectral efficiency is increased. The current FCC Rule governing radiated power in the Cellular Radiotelephone Service (Section 22.913) states - *the effective radiated power of base transmitters and cellular repeaters must not exceed 500 watts.* Since this power limit was enacted prior to the development and use of MIMO techniques, it was generally understood that a single transmitter used a single carrier frequency and the power requirement was related to this carrier frequency. A 2x2 MIMO deployment, which employs a single carrier channel on two transmitters, must split the maximum radiated power given in the FCC Rules between the two MIMO transmitters. This power split reduces the service coverage area of the transmitters operating in the MIMO mode compared to that of a single transmitter deployment.

In 2004, recognizing the problem posed by the then current power limitation rules, CTIA offered a technologically neutral proposal to modify base station power limits for PCS licensees. Subsequently, the Commission expanded this proposal to include not only PCS, but also cellular radio service and other service bands. In 2008, following comments on the proposal, the FCC revised the radiated power rules for certain services, notably PCS and AWS, but declined to extend the revision to cellular radio service because the frequencies immediately adjacent to the 850 MHz cellular band were undergoing significant restructuring and "until [it could] better assess the impact of additional power limit changes" on the possibility of harmful interference to adjacent bands. Since then, re-banding of services adjacent to the cellular band is almost complete and there has been adequate time to understand the interference concerns, if any, due to the adoption of Power Spectral Density (PSD) rules in PCS and AWS bands. Such a PSD limit would allow the use of MIMO techniques in the 850 MHz band without requiring a reduction in the service coverage area, and would be more consistent with FCC broadband power limit rules in other bands. A PSD limit specifies the amount of power that is distributed with frequency and, in the case of the cellular radiotelephone service, it is the amount of power distributed over a radio channel. If the maximum radiated power in a 5 MHz channel is 1500 watts, the PSD would be 300 watts/MHz (1500 watts/5 MHz).

Believing that a PSD measure should now be adopted for the cellular bands, AT&T conducted a technology interference comparison analysis of its third generation (3G) UMTS and 4G LTE technologies to show that a power limit based on a Power Spectral Density measure will not increase the possibility of harmful interference to adjacent bands and would also maintain the "status quo" with respect to the potential impact on users of adjacent spectrum, such as the Public Safety Radio Service. The results of the technology interference comparison supported AT&T's belief. The study results also supported a Power Spectral Density limit greater than 100 Watts/MHz.

To further bolster AT&T's belief that a power limit based on a Power Spectral Density measure will not increase the possibility of harmful interference to adjacent bands, AT&T completed a second "real world" study which determined the interference impacts on users of adjacent spectrum as a result of its technology migration through the years – from second generation (2G) GSM (Global Systems for Mobile Communications) to 4G LTE with MIMO. AT&T's technology migration study commences with the deployment of 2G GSM technology employing a tri-sectored frequency reuse pattern of N=12 that typically allowed on average up to five GSM carriers per sector. With the migration to broadband 3G UMTS technology, some GSM carriers were replaced with a single UMTS carrier. A typical sector in an initial 3G network would include one UMTS and three GSM carriers. As broadband demand increased, the spectrum for a second UMTS carrier was again re-farmed from existing GSM carriers. A typical congested metro market deploys two UMTS carriers along with two GSM carriers per sector. As the data traffic demand increased, a migration to 4G LTE in the cellular bands will be necessary. LTE deployments will precede by replacing one of the UMTS carriers with a 5 MHz LTE carrier employing 2X2 MIMO. Initial deployments of LTE will include a 5 MHz UMTS carrier, a 5 MHz LTE carrier, and two GSM carriers in the cellular band. The final migration will be to replace the remaining UMTS and GSM carriers and to upgrade the 5 MHz LTE carrier to a 10 MHz LTE carrier. The LTE deployments will be with two transmitters per carrier/sector as compared to a single transmitter per carrier/sector with UMTS. This paper documents the final results of that study.

1. Modeling the Interference Environment

Modeling the interference environment consisted of the following five steps:

1. Model the interference path
2. Determine the transmitter and receiver characteristics
3. Model the interference mechanisms
4. Calculate the interference levels and determine their impacts

1.1 Modeling the Interference Path

Since the interference network environment is that of a standard cellular architecture, two propagation loss models were used to calculate path loss. These two propagation loss models were the HATA loss models and the modified Friis Transmission Loss model. The HATA models are the most widely used radio frequency propagation models for predicting the behavior of cellular transmissions. Since the HATA models are accurate for link distances between 1 and

20 kilometers, another model was needed for paths closer to the cell site. The Friis Transmission Loss model is ideal for paths between two isotropic antennas in free space (Line-of-Sight) and can be modified for paths other than free space (Non-Line-of-Sight). All loss models were incorporated into the Friis Transmission Equation which relates received power, transmit power, antenna gains and path loss in order to calculate interference levels. For line-of-sight paths a propagation constant of 2 was used and for non-line-of-sight paths, a propagation constant of 2.4 was used. Cellular antenna heights for non-rural areas of Vermont used the average antenna height in the Vermont market - 24 meters. For rural areas of Vermont where antenna heights are generally higher, antenna heights of 47 and 92 meters were used.

1.2 Determining the Transmitter and Receiver Characteristics

The transmitter and receiver characteristics were:

- Maximum transmit power
- Base station antenna gains and discrimination
- Transmission line loss
- Transmitter sideband emission levels
- Public Safety receiver noise floor
- Minimum mobile Adjacent Channel Rejection Ratio
- Minimum portable Adjacent Channel Rejection Ratio
- Public Safety mobile antenna gain: From an Internet site on Public Safety equipment
- Public Safety portable antenna gain: From an Internet site on Public Safety equipment
- Public Safety Receiver Overload level
- Third Order Intercept Point calculation: From *Motorola paper by Bruce Oberlies – "Public Safety Interference Environment – Raising Receiver Performance Requirements"*
- Third Order Interference Level calculation: From Aeroflex Application Note on Intermodulation Distortion on the website www.aeroflex.com.

1.3 Modeling the Interference Mechanism

The three near/far interference mechanisms common in Public Safety interference environments were modeled in the following manner:

1. Intermodulation – The receive interference level at the input to the Public Safety receiver's front end was calculated using the appropriate Friis Transmission Equation. The study assumed that the GSM channels were transmitting at 500 Watts, UMTS channels were transmitting at 500 Watts, and LTE at 500 Watts/transmitter-antenna for a 5 MHz channel and 1000 Watts/transmitter-antenna for a 10 MHz channel. Since Effective Radiated Power level is the power level radiating from the base station's antenna, no transmission line loss or base station antenna gain was included in this calculation. It was assumed that these levels were the levels of the two interfering signals creating the intermodulation product. The third order intercept point was calculated using the formula in the Motorola paper and this value was used in the Aeroflex equation with

the interference levels calculated from the Friis Transmission Equation to obtain the level of the third order product in the receiver.

2. Transmitter Sideband Emissions - The transmitter sideband emission level at the input to the Public Safety receiver's front end was calculated using the appropriate Friis Transmission Equation. The sideband transmit power level at the output of the transmitter used in this equation was the measured spurious emissions level given by the manufacturer. For this calculation in the Friis Transmission Equation, transmission line loss and base station antenna gain were included.

3. Receiver Overload - The received interference level at the input to the Public Safety receiver's front end was calculated using the appropriate Friis Transmission Equation. The cellular base station transmit power level used in this equation was the maximum Effective Radiated Power level specified in the FCC Rules for Cellular services in the 850 MHz cellular band for 2G and 3G technologies (GSM channels were transmitting at 500 Watts, UMTS channels were transmitting at 500 Watts, and LTE at 500 Watts/transmitter-antenna for a 5 MHz channel and 1000 Watts/transmitter-antenna for a 10 MHz channel). Since Effective Radiated Power level is the power level radiating from the base station's antenna, no transmission line loss or base station antenna gain was included in this calculation.

1.4 Interference Levels and Their Impacts

An Excel spreadsheet was developed to make the above mentioned calculations and determine the impacts of the various interference mechanisms. For the intermodulation interference calculation and the transmitter sideband emission interference calculation, the criteria used to determine impact was a rise in the receiver's noise floor. For Receiver Overload interference calculations, the criteria used to determine impacts was that any interfering level that was less than the specified overload point of the receiver is an acceptable interfering level. For this study only the relative levels of the interference environments are compared. Only in situations where a technology's interference environment level is no worse than the existing technology's interference environment level can the interference level be deemed acceptable (Status Quo).

The study addresses the interference impacts on Public Safety receivers under five different cases that are representative of AT&T's past, present, and future network comprising GSM, UMTS and LTE systems in various configurations in the cellular band. Case one represents an initial 2G GSM deployment of five GSM carriers. Case two addresses the migration to one UMTS carrier and three GSM carriers. Case three represents the migration to two UMTS carriers along with two GSM carriers per sector. Case four represents a migration to 4G LTE with a 5 MHz UMTS carrier, a 5 MHz LTE carrier with MIMO, and two GSM carriers. The final migration, Case five, will be to a single 10 MHz LTE carrier with MIMO.

2. Study Results

With a single GSM channel's transmit power level set to 500 Watts, a single UMTS channel set to 500 Watts, and a LTE channel set to 500 Watts/transmitter-antenna for a 5 MHz channel and

1000 Watts/transmitter-antenna for a 10 MHz channel, the results of the Excel spreadsheet calculations of interference into Public Safety receivers with bandwidths of 25 and 12.5 KHz from the five migration cases for non-rural and rural environments are shown in Tables 1 through 12. Bracketed numbers in the overload tables are received overload interference levels in dBm.

2.1 Intermodulation Interference Impacts

	PS RECEIVER BANDWIDTH = 25 KHz				
DISTANCE TO MOBILE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	2500 W	2000 W	2000 W	2500 W	2000 W
Allowed Now	YES	YES	YES	NO	NO
40	9.4362	9.4362	9.4362	9.4362	0.0173
200	6.4700	6.4700	6.4700	6.4700	0.0076
>1000	0.0482	0.0482	0.0482	0.0482	0.0000

	PS RECEIVER BANDWIDTH = 12.5 KHz				
DISTANCE TO MOBILE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	2500 W	2000 W	2000 W	2500 W	2000 W
Allowed Now	YES	YES	YES	NO	NO
40	18.0114	18.0114	18.0114	18.0114	0.1363
200	14.5468	14.5468	14.5468	14.5468	0.0607
>1000	0.3717	0.3717	0.3717	0.3717	0.0002

TABLE 1. Non-Rural Mobile Intermodulation Impacts

	PS RECEIVER BANDWIDTH = 25 KHz				
DISTANCE TO PORTABLE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	2500 W	2000 W	2000 W	2500 W	2000 W
Allowed Now	YES	YES	YES	NO	NO
40	0.0043	0.0043	0.0043	0.0043	0.0000
200	0.0019	0.0019	0.0019	0.0019	0.0000
>1000	0.0482	0.0482	0.0482	0.0482	0.0000

	PS RECEIVER BANDWIDTH = 12.5 KHz				
DISTANCE TO PORTABLE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	2500 W	2000 W	2000 W	2500 W	2000 W
Allowed Now	YES	YES	YES	NO	NO
40	0.0339	0.0339	0.0339	0.0339	0.0000
200	0.0104	0.0104	0.0104	0.0104	0.0000
>1000	0.0000	0.0000	0.0000	0.0000	0.0000

TABLE 2. Non-Rural Portable Intermodulation Impacts

	PS RECEIVER BANDWIDTH = 25 KHz (Ant Height = 47 m)				
DISTANCE TO MOBILE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	5000 W	4000 W	4000 W	5000 W	4000 W
Allowed Now	YES	YES	YES	NO	NO
40	0.5766	0.5766	0.5766	0.5766	0.0000
200	8.9790	8.9790	8.9790	8.9790	0.0019
>1000	1.0994	1.0994	1.0994	1.0994	0.0001

	PS RECEIVER BANDWIDTH = 12.5 KHz (Ant Height = 47 m)				
DISTANCE TO MOBILE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	5000 W	4000 W	4000 W	5000 W	4000 W
Allowed Now	YES	YES	YES	NO	NO
40	3.2957	3.2957	3.2957	3.2957	0.0003
200	17.5004	17.5004	17.5004	17.5004	0.0076
>1000	5.1913	5.1913	5.1913	5.1913	0.0006

	PS RECEIVER BANDWIDTH = 25 KHz (Ant Height = 92 m)				
DISTANCE TO MOBILE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	5000 W	4000 W	4000 W	5000 W	4000 W
Allowed Now	YES	YES	YES	NO	NO
40	0.0000	0.0000	0.0000	0.0000	0.0000
200	0.0076	0.0076	0.0076	0.0076	0.0000
>1000	3.3683	3.3683	3.3683	3.3683	0.0003

	PS RECEIVER BANDWIDTH = 12.5 KHz (Ant Height = 92 m)				
DISTANCE TO MOBILE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	5000 W	4000 W	4000 W	5000 W	4000 W
Allowed Now	YES	YES	YES	NO	NO
40	0.0003	0.0003	0.0003	0.0003	0.0000
200	0.0601	0.0601	0.0601	0.0601	0.0000
>1000	10.1597	10.1597	10.1597	10.1597	0.0026

TABLE 3. Rural Mobile Intermodulation Impacts

	PS RECEIVER BANDWIDTH = 25 KHz (Ant Height = 47 m)				
DISTANCE TO PORTABLE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	5000 W	4000 W	4000 W	5000 W	4000 W
Allowed Now	YES	YES	YES	NO	NO
40	0.0001	0.0001	0.0001	0.0001	0.0000
200	0.0038	0.0038	0.0038	0.0038	0.0000
>1000	0.0002	0.0002	0.0002	0.0002	0.0000

	PS RECEIVER BANDWIDTH = 12.5 KHz (Ant Height = 47 m)				
DISTANCE TO PORTABLE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	5000 W	4000 W	4000 W	5000 W	4000 W
Allowed Now	YES	YES	YES	NO	NO
40	0.0006	0.0006	0.0006	0.0006	0.0000
200	0.0301	0.0301	0.0301	0.0301	0.0153
>1000	0.0013	0.0013	0.0013	0.0013	0.0000

	PS RECEIVER BANDWIDTH = 25 KHz (Ant Height = 92 m)				
DISTANCE TO PORTABLE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	5000 W	4000 W	4000 W	5000 W	4000 W
Allowed Now	YES	YES	YES	NO	NO
40	0.0001	0.0001	0.0001	0.0001	0.0000
200	0.0038	0.0038	0.0038	0.0038	0.0000
>1000	0.0006	0.0006	0.0006	0.0006	0.0000

	PS RECEIVER BANDWIDTH = 12.5 KHz (Ant Height = 92 m)				
DISTANCE TO PORTABLE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	5000 W	4000 W	4000 W	5000 W	4000 W
Allowed Now	YES	YES	YES	NO	NO
40	0.0000	0.0000	0.0000	0.0000	0.0000
200	0.0000	0.0000	0.0000	0.0000	0.0000
>1000	0.0051	0.0051	0.0051	0.0051	0.0000

TABLE 4. Rural Portable Intermodulation Impacts

The results above show that for intermodulation interference at the three distances from the cellular base station site (40 meters, 200 meters, and 1000 meters) for all migration paths, the noise floor rise for LTE deployments with MIMO were below 1 dB and were significantly less than present technology deployments. The higher and consistently uniform interference level for those cases involving GSM are driven only by much higher PSD of the GSM carrier. Thus this worst case interference effect remains the same regardless of the number of GSM carriers that are present. In practice where interference cases have been identified, judicious shuffling of the GSM carriers amongst various frequencies has allowed IM interference to be mitigated.

Tables 1 through 4 show Case 4, which is represented by each sector deploying one UMTS carrier transmitting at 500 W, one 5 MHz LTE carrier transmitting at 1000 W and two GSM carriers transmitting 500 watts each, will not cause any additional interference from intermodulation (IM) into Public Safety receivers as compared to existing UMTS or GSM systems.

2.2 Sideband Interference Impacts

	PS RECEIVER BANDWIDTH = 25 KHz				
DISTANCE TO MOBILE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	2500 W	2000 W	2000 W	2500 W	2000 W
Allowed by FCC Rules	Yes	Yes	Yes	No	No
40	0.0271	0.0216	0.0216	0.0271	0.0271
200	0.0207	0.0164	0.0164	0.0207	0.0207
>1000	0.0024	0.0019	0.0019	0.0024	0.0031

DISTANCE TO MOBILE RECEIVER (METERS)	PS RECEIVER BANDWIDTH = 12.5 KHz				
	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	2500 W	2000 W	2000 W	2500 W	2000 W
Allowed by FCC Rules	Yes	Yes	Yes	No	No
40	0.0271	0.0216	0.0216	0.0271	0.0271
200	0.0207	0.0164	0.0164	0.0207	0.0207
>1000	0.0024	0.0019	0.0019	0.0024	0.0031

TABLE 5. Non-Rural Mobile Sideband Impacts

DISTANCE TO PORTABLE RECEIVER (METERS)	PS RECEIVER BANDWIDTH = 25 KHz				
	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	2500 W	2000 W	2000 W	2500 W	2000 W
Allowed Now	YES	YES	YES	NO	NO
40	0.0136	0.0108	0.0108	0.0136	0.0136
200	0.0104	0.0082	0.0082	0.0104	0.0104
>1000	0.0012	0.0010	0.0010	0.0012	0.0015

DISTANCE TO PORTABLE RECEIVER (METERS)	PS RECEIVER BANDWIDTH = 12.5 KHz				
	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	2500 W	2000 W	2000 W	2500 W	2000 W
Allowed Now	YES	YES	YES	NO	NO
40	0.0136	0.0108	0.0108	0.0136	0.0136
200	0.0104	0.0082	0.0082	0.0104	0.0104
>1000	0.0012	0.0010	0.0010	0.0012	0.0015

TABLE 6. Non-Rural Portable Sideband Impacts

	PS RECEIVER BANDWIDTH = 25 KHz (Ant Height = 47 m)				
DISTANCE TO MOBILE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	5000 W	4000 W	4000 W	5000 W	4000 W
Allowed Now	YES	YES	YES	NO	NO
40	0.0036	0.0028	0.0028	0.0036	0.0036
200	0.0131	0.0104	0.0104	0.0131	0.0065
>1000	0.0045	0.0036	0.0036	0.0045	0.0045

	PS RECEIVER BANDWIDTH = 12.5 KHz (Ant Height = 47 m)				
DISTANCE TO MOBILE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	5000 W	4000 W	4000 W	5000 W	4000 W
Allowed Now	YES	YES	YES	NO	NO
40	0.0036	0.0216	0.0216	0.0036	0.0036
200	0.0131	0.0104	0.0104	0.0131	0.0131
>1000	0.0045	0.0036	0.0036	0.0045	0.0045

	PS RECEIVER BANDWIDTH = 25 KHz (Ant Height = 92 m)				
DISTANCE TO MOBILE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	5000 W	4000 W	4000 W	5000 W	4000 W
Allowed Now	YES	YES	YES	NO	NO
40	0.0001	0.0001	0.0001	0.0001	0.0001
200	0.0008	0.0007	0.0007	0.0008	0.0008
>1000	0.0072	0.0057	0.0057	0.0072	0.0072

	PS RECEIVER BANDWIDTH = 12.5 KHz (Ant Height = 92 m)				
DISTANCE TO MOBILE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	5000 W	4000 W	4000 W	5000 W	4000 W
Allowed Now	YES	YES	YES	NO	NO
40	0.0001	0.0001	0.0001	0.0001	0.0001
200	0.0008	0.0007	0.0007	0.0008	0.0008
>1000	0.0072	0.0057	0.0057	0.0072	0.0072

TABLE 7. Rural Mobile Sideband Impacts

	PS RECEIVER BANDWIDTH = 25 KHz (Ant Height = 47 m)				
DISTANCE TO PORTABLE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	5000 W	4000 W	4000 W	5000 W	4000 W
Allowed Now	YES	YES	YES	NO	NO
40	0.0018	0.0014	0.0014	0.0018	0.0018
200	0.0065	0.0052	0.0052	0.0065	0.0033
>1000	0.0023	0.0018	0.0018	0.0023	0.0023

	PS RECEIVER BANDWIDTH = 12.5 KHz (Ant Height = 47 m)				
DISTANCE TO PORTABLE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	5000 W	4000 W	4000 W	5000 W	4000 W
Allowed Now	YES	YES	YES	NO	NO
40	0.0018	0.0014	0.0014	0.0018	0.0018
200	0.0065	0.0052	0.0052	0.0065	0.0065
>1000	0.0029	0.0018	0.0018	0.0029	0.0023

	PS RECEIVER BANDWIDTH = 25 KHz (Ant Height = 92 m)				
DISTANCE TO PORTABLE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	5000 W	4000 W	4000 W	5000 W	4000 W
Allowed Now	YES	YES	YES	NO	NO
40	0.0001	0.0001	0.0001	0.0001	0.0001
200	0.0004	0.0003	0.0003	0.0004	0.0004
>1000	0.0036	0.0029	0.0029	0.0036	0.0036

	PS RECEIVER BANDWIDTH = 12.5 KHz (Ant Height = 92 m)				
DISTANCE TO PORTABLE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	5000 W	4000 W	4000 W	5000 W	4000 W
Allowed Now	YES	YES	YES	NO	NO
40	0.0001	0.0001	0.0001	0.0001	0.0001
200	0.0004	0.0003	0.0003	0.0004	0.0004
>1000	0.0036	0.0029	0.0029	0.0036	0.0036

TABLE 8. Rural Portable Sideband Impacts

Similarly, for Sideband emissions at the three distances from the cellular base station site (40 meters, 200 meters, and 1000 meters) for all migration paths, all noise floor rises were below 1 dB. The tables show a slight increase in interference from Sideband emissions between some scenarios deploying LTE with increased power and less cable loss (Case 4 and Case 5) than existing GSM and UMTS systems as represented by Case 1, 2 and 3. This rise in the interference floor is insignificant in practice and is still well under the 1 dB degradation in the noise floor of the Public Safety mobile receiver.

2.3 *Overload Interference Impacts*

	PS RECEIVER BANDWIDTH = 25 KHz				
DISTANCE TO MOBILE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	2500 W	2000 W	2000 W	2500 W	2000 W
Allowed Now	YES	YES	YES	NO	NO
40	YES (-21.1)	YES (-22)	YES (-22)	YES (-21.1)	YES (-22)
200	YES (-22.2)	YES (-23.2)	YES (-23.2)	YES (-22.2)	YES (-23.2)
>1000	NO	NO	NO	NO	NO

	PS RECEIVER BANDWIDTH = 12.5 KHz				
DISTANCE TO MOBILE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	2500 W	2000 W	2000 W	2500 W	2000 W
Allowed Now	YES	YES	YES	NO	NO
40	YES(-21.1)	YES(-22.0)	YES (-22)	YES(-21.1)	YES (-22)
200	YES(-22.2)	YES(-23.2)	YES (-23.2)	YES(-22.2)	YES (-23.2)
>1000	NO	NO	NO	NO	NO

TABLE 9. Non-Rural Mobile Overload Impacts

	PS RECEIVER BANDWIDTH = 25 KHz				
DISTANCE TO PORTABLE RECEIVER (METERS)	CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	2500 W	2000 W	2000 W	2500 W	2000 W
Allowed Now	YES	YES	YES	NO	NO
40	YES(-24.1)	YES(-25)	YES (-25)	YES(-24.1)	YES(-25)
200	YES(-25.2)	YES(-26.2)	YES (-26.2)	YES(-25.2)	YES(-26.2)
>1000	NO	NO	NO	NO	NO

DISTANCE TO PORTABLE RECEIVER (METERS)	PS RECEIVER BANDWIDTH = 12.5 KHz CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	2500 W	2000 W	2000 W	2500 W	2000 W
Allowed Now	YES	YES	YES	NO	NO
40	YES(-24.1)	YES(-25)	YES (-25)	YES(-24.1)	YES(-25)
200	YES(-25.2)	YES(-26.2)	YES (-26.2)	YES(-25.2)	YES(-26.2)
>1000	NO	NO	NO	NO	NO

TABLE 10. Non-Rural Portable Overload Impacts

DISTANCE TO MOBILE RECEIVER (METERS)	PS RECEIVER BANDWIDTH = 25 KHz (Ant Height = 47 m) CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	5000 W	4000 W	4000 W	5000 W	4000 W
Allowed Now	YES	YES	YES	NO	NO
40	YES(-26.8)	YES(-27.8)	YES(-27.8)	YES(-26.8)	NO
200	YES(-21.2)	YES(-22.2)	YES(-22.2)	YES(-21.2)	YES(-25.2)
>1000	YES(-25.8)	YES(-26.8)	YES(-26.8)	YES(-25.8)	YES(-29.8)

DISTANCE TO MOBILE RECEIVER (METERS)	PS RECEIVER BANDWIDTH = 12.5 KHz (Ant Height = 47 m) CASE 1 5 GSM CXRS (dB)	CASE 2 1 UMTS & 3 GSM CXRS (dB)	CASE 3 2 UMTS CXRS & 2 GSM CXRS (dB)	CASE 4 1 FIVE MHz LTE CXR, 1 UMTS CXR & 2 GSM CXRS (dB)	CASE 5 1 TEN MHz LTE CXR (dB)
Power/Sector	5000 W	4000 W	4000 W	5000 W	4000 W
Allowed Now	YES	YES	YES	NO	NO
40	YES(-26.8)	YES(-27.8)	YES(-27.8)	YES(-26.8)	NO
200	YES(-21.2)	YES(-22.2)	YES(-22.2)	YES(-21.2)	YES(-25.2)
>1000	YES(-25.8)	YES(-26.8)	YES(-26.8)	YES(-25.8)	YES(-29.8)